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Die Head for Extruding Films with Fastening Elements which Contain Lines for Cool Air

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The invention relates to a tubular film die head (1) for extruding single-layer or multi-layer film which has at least the following features:

- a substantially annular die gap (11),
- fastening means which fix at least two components (5, 7, 8, 9) with respect to one another which together border areas (14) bearing plastic melt within the tubular film die head,
- coolant-carrying elements.

The extruded tubular films find use in the packaging material industry, among others.

Tubular film die heads of the type cited are, for example, shown in EP 0 626 247 A1, US 5,069,612, and in DE 100 01 363 A1. In all the tubular film die heads of this type there is the necessity of distributing plastic melt, which is conveyed in the lines, within the die head so that it reaches an annular die gap relatively uniformly. In this way the plastic melt is formed into a film tube.

Among other things, for reasons of manufacturing technology (of the die head), at least one part of the distribution process of the plastic melt is, as a rule, is done by plastic melt-carrying areas which are

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done by plastic melt-carrying areas which are bounded by at least two components. The aforementioned publications show that the geometric structure of these areas can be realized in the most varied forms.

Due to the substantial pressure which the melt is under, forces act on these components, often called lifting forces. Among other things, these forces must be absorbed by robust fastening elements which often have a not insignificant demand for volume.

After extrusion, the film tube is conveyed as a rule to a squeezing device and later to a reversing device. This state of affairs, such as the reel of the die head, squeezing roller, and reversing are known and represented by EP 0 873 846 A2, among others.

Due to this situation the film tube is closed from above and from the sides. Thus, for example, the intake and discharge of coolants, such as, for example, coolant air for the cooling of the interior of the tube, must be done through the die head. Since the lines for feeding the plastic melt, fastening elements, and electric lines for sensor and heating elements and the like must also be conducted through the die head, the design of the die head becomes extraordinarily complicated. In particular, US 5,538,411 shows the complexity of the die head design. In this publication fastening elements as well as coolant lines are shown, among other things.

Often the arrangement of said lines is done at the expense of the height of the die head. However, the height should actually be kept very small in order to protect the plastic melt.

Thus, the publications US 4,003,972, US [sic] 3 471 89, and GB 1 253 454 shows die heads in each of which a fastening element with a coolant line is provided. The die head patented in DE 100 48 862 C2 is to be considered as a further development of this type of die head which comprises a fastening element in which two coolant lines are integrated. Due to these two integrated coolant lines such a fastening element assumes a significant volume.

ART 34 AMDT

Thus, the objective of the present invention consists of proposing a die head in which the volume of the die head is utilized more efficiently.

The objective is realized by the characterizing clause of Claim 1.

ART 34 AMDT

It is recommended to cover either the fastening means, the holes, or both elements with thermally insulating materials since the coolant should arrive as cool as possible through the significantly heated die head. As a rule at least air is used as coolant.

Teflon and, in given cases, ceramic materials, among others, come into consideration as insulating material. Since gases such as air, or even a vacuum, possess very good insulating properties, suitable cavities can also be provided.

In many die heads according to the state of the art the coolant air is conducted through lines which lie in the center of the die head. However, such an arrangement of the air lines prevents the feeding of the melt through melt lines which are often guided in the center of the die heads or at least branch from a central position as shown in Figures 1 to 5. The eccentric disposition, in particular of several fastening means, is to remedy this problem.

Advantageously, the fastening means have the form of a circular cylinder. The fastening means such as, in particular, the screws, systems of threaded bolts and nuts, and systems of screws and nuts can work in the fixation of the various components.

As already mentioned repeatedly, coolants, as a rule, flow through fastening elements according to the invention and are thus often less heated than the housing of the die head.

These circumstances can be utilized by the fastening elements being only loosely constrained in their mounting. If the die head in operation assumes a higher temperature than the fastening elements, it will (with the same, or a similar, coefficient of expansion) also expand more strongly than them so that the fastening elements are stretched out more strongly and, in given cases, develop their full fixation effect.

Additional advantageous forms of embodiment and embodiment examples of the invention follow from the additional claims, the description of the object, and the drawings.

The individual figures show

Figure 1 a section through a die head along the line B-B from Figure 2,

Figure 2 a section along the line A-A from Figure 1,

Figure 3 a section through an additional embodiment example of the invention,

Figure 4 a section through an additional embodiment example of the invention,

Figure 5 a section through an additional embodiment example of the invention.

Figure 1 shows a section through an embodiment example of a tubular film die head 1 according to the invention, the bearing end of said tubular film die head being the housing 2 which in turn consists of the external nozzle ring 3, the housing ring 4, the housing base plate 5, and the connecting plate 6. In the circular interior of the housing, above all, are located the two bars 7 and 8 as well as the inner nozzle ring 9. The components of the housing 2 and the aforementioned parts 4 to 6 bound an annular gap 10 through which the plastic melt reaches the die gap 11 and forms the film tube 12.

The plastic melt arrives in the aforementioned gap 10 through the feed lines 13. Before the mouth into the gap 10, the feed lines are realized as helical grooves in the bars 7 and 8 as well as the housing base plate 5. In this case the helical grooves are each bounded above by the component 7, 8, 9 which is located above the component 5, 7, 8 in which the grooves are introduced. Due to the high pressure which prevails in the feed lines during operation, great lifting forces act on the bars 7 and 8 and the inner nozzle ring 9, said forces having to be absorbed by the fastening means 15a and b.

In the embodiment example represented in Figure 1 the ends of the fastening means are provided with outer threads on each of which a nut 16 is mounted. The fastening means 15 b contain air intake lines 24b through which air is conducted to the cooling lips 17 of the interior air cooling at the interior edge of the film tube 12.

The discharge of heated air is done by the stand pipe 18 and the fastening elements 15a which contain air exhaust pipes 24a.

Worth mentioning in addition is the advantageous distribution of the plastic melt through branching points 19 which are disposed in the center of the die head, as can also be seen in Figure 2. The melt is conveyed via the central feed lines 20.

Figures 3 to 5 show different possibilities for constraining the fastening elements 15. In Figure 3 the lower part of the hole for the fastening elements in the connecting plate 6 is provided with an inner thread 21 in which the outer thread 22 of the fastening elements 15 engages. The upper ends of the fastening elements 15 are once again provided with outer threads 22 and nuts 16. Often it is advantageous to provide the upper part of the hole for the fastening elements with a thread and to screw the fastening element into said thread. However, graphical representation of this form of embodiment was omitted.

In Figure 4 heads 23 assume the role of the latter nuts 16. The fastening of the lower ends of the fastening elements 15b is done once again by screwing the same 15b to the connecting plate 6. The fastening elements 15a again have a nut at this point. Figure 5 illustrates once more the fastening of the fastening elements with the nuts 16.

In the shown embodiment examples of the invention each fastening element 15 contains a line 24. However, it is just as well conceivable that fastening elements contain an exhaust line 24a and an intake line 24b. Other fastening elements can also get by without such lines 24.

List of Reference Numbers	
1	Tubular film die head
2	Housing
3	Outer nozzle ring
4	Housing ring
5	Housing base plate
6	Connecting plate
7	Bar
8	Bar
9	Inner nozzle ring
10	Annular gap
11	Nozzle gap
12	Film tube
13	Feed lines
14	Helical grooves
15 a, b	Fastening elements
16	Nut
17	Cooling lips
18	Stand pipe
19	Branching points
20	Central feed lines
21	Inner thread of the hole for the fastening elements
22	Outer thread of the fastening elements
23	Head of the fastening elements
24 a, b	Lines
25	Insulating layer of the fastening element
26	
27	
28	